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by

CHRISTINA A. SMITH, M.A., B.Ed.

With
A STATISTICAL ANALYSIS
by
D. N. LAWLEY, M.A., D.Sc.

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PREFACE

While there are cells in Lanarkshire where Lithuanian is the language of the household, and likewise in Scotland small Jewish communities where either Hebrew or Yiddish is in use in the home, the Committee on Bilingualism of the Scottish Council for Research in Education inevitably turned to the Gaelic-speaking area of Scotland for its first attack on the problems of bilingualism.

By reason of its limited resources the Research Council has in large measure been compelled to restrict its operations to projects which could be undertaken voluntarily by qualified workers. The Committee on Bilingualism has been fortunate in enlisting the services of Miss Christina A. Smith, a Gaelic-speaking Bachelor of Education of Edinburgh University, who devoted her vacation to the testing of Hebridean children. Mr J. R. Morrison undertook the statistical work in connection with the 1943 investigation, and along with Dr D. N. Lawley planned the 1945 investigation. Dr Lawley has applied the analysis of variance to the data of the later investigation.

The English publishers of the Terman-Merrill and other tests employed granted permission for, and members of the Committee on Bilingualism undertook, the translation of these into Gaelic.

The Education Authority for Ross and Cromarty, under whose jurisdiction for educational purposes the island of Lewis comes, and the Director of Education afforded the necessary facilities for testing, and the teachers of Lewis rendered valuable assistance to the tester.

To all who have thus co-operated, the Committee on Bilingualism and the Research Council desire to express their indebtedness.

GODFREY THOMSON

Convener of the Committee on Bilingualism

TESTING AND RESULTS

A DEMAND for the study of bilingualism and its inherent problems in Scotland has arisen out of the competing linguistic influences which characterise twentieth-century life in the Scottish Highlands; for Gaelic, having fallen almost entirely into disuse on the mainland, is still generally spoken in the Western Isles. Some years ago a special committee of the Scottish Council for Research in Education was charged with the task of investigating the problems of bilingualism under the present system of administration, and has sought some means of measuring the effects of the duality of linguistic influences on the educational development of the bilingual child. The work of the Committee on Bilingualism is of high constructive value in directing attention to a problem which has its genesis in the tacit assumption that Gaelic-speaking Scots form such a small minority that no special administration is needed. Probably this attitude is largely responsible for the rapid decline of an ancient and historic language.

Educational problems in bilingualism have their origins in the peculiar combination of influences of the English and Gaelic languages in the life of the school child. While the structure of the social unit in those islands has fostered traditional Gaelic trends on the one hand, external pressure—commercial and economic—has been instrumental in supplanting Gaelic to a great extent. Gaeldom might have done well to resist that pressure and to strive with greater energy to reinforce its individuality, as a safeguard against the possible eclipse of its language. The position to-day is that Gaelic-speaking children attending State schools are taught in English throughout the entire course of their schooling. As it seemed from the results of tests previously administered in the schools of Gaelic-speaking communities that raw scores—and consequently intelligence quotients—tended to be lower than was warranted on the assumption of a normal distribution, some doubts were cast upon the testing media, or rather upon their efficacy in the special circumstances. On the hypothesis, then, that testing in Gaelic might produce more genuine results, the Research Council's Committee on Bilingualism planned its investigations.

During the summer of 1943 the writer was invited to undertake the testing of a sample of bilingual children in the Western Isles of Scotland. The island of Lewis seemed to be the obvious choice for the setting of the experiment since she knew that particular island well, having spent many summer vacations there.

A general survey of the conditions of life in the island of Lewis will perhaps show something of the complexity of the problems of bilingualism in schools. Lewis, with Harris, forming the largest island of the western group, owes its general character to its insularity. Remoteness from the rest of the country has resulted in the unfettered development of a rural rather than an industrial civilisation, so that one town of moderate size has sufficed to meet the economic needs of the Isles people. In the villages and townships the people are purely Gaelic-speaking, and every form of social intercourse is effected through the medium of the Gaelic language by reason of ancient tradition. Its dominance is unassailed in rural Lewis, but not in the town of Stornoway where the population is largely English-speaking. The gradual ascendancy of English, in the course of mercantile expansion there, has now established that language.

Although many of the townspeople, being of rural ancestry, have a knowledge of Gaelic, the language has declined because of the infiltration of exclusively English-speaking people into the professions and into technical and commercial concerns. (This is true of its immediate environs, as well as of Stornoway.)

Rural Lewis, however, shows no tendency towards falling into line with its capital in this respect, for the very essence of a rural civilisation precludes a ready acceptance of modern trends in any direction. That is why Gaelic, the mother-tongue of generations of Lewis crofters and seafarers in the past, directs the life of the island to-day. It is the language of the home, the street and the church. Only at school is English generally heard. Inevitably, then, the five-year-old entrant in a rural school expresses himself in Gaelic, his mother-tongue. Occasionally children may know some English—this depends upon circumstances in the home—but such cases are uncommon. Crofters' children rarely know English at the school entrance stage. Consequently it is not in the first place with the teaching of reading, writing, spelling and arithmetic that the infant divisions of rural schools are concerned but with the teaching of simple English. Only after mastering this second language can the child, under the present educational regime, be taught to read, write, spell and count in English. Teachers charged with this responsibility must, of course, be bilingual, otherwise there would be deadlock at the outset between the English-speaking teacher and the Gaelic-speaking child. This early imposition upon Gaelic-speaking (and Gaelic-thinking) children of English as the language of the schoolroom would appear to impede considerably progress in school subjects during the early years of the child's school life.

The magnitude of the task of teaching—and of learning—English under these conditions is obvious, in view of the fact that the school is the sole agency for propagating a knowledge of English. Most Lewis children hear no English spoken between the end of the one school-day and the beginning of the next, when lessons in English are resumed. They may, or may not, have an opportunity of reading English books, if they are old enough to take advantage of it. More often than not suitable books are unobtainable at home. There is a woeful scarcity of reading-matter for children unless it is supplied by the enterprise of a teacher, who may very occasionally form a class library on a limited scale. But, generally speaking, the provision of books to read is at best inadequate, and perhaps entirely lacking. Such a lack of facilities is clearly prejudicial to subsequent scholastic success, at least in a literary direction.

Another handicap affecting a proportion of school-children in Lewis is the long distances which many of them have to cover in going to and coming from school. The distribution of schools throughout the island has been based on fairly extensive units of area because of the relatively small numbers of children per unit, and perhaps of the probable difficulty of staffing. There are a few 'side' schools in the island to cater for the few who live in the most distant places, but many children still walk several miles to school. This distance factor, therefore, takes a heavy toll of school attendance because of the incidence of rainstorms and gales during the greater part of the year. Indeed, bad weather and illness are the sole causes of absence from school. Truancy is unknown; for parents value education highly and extend full co-operation to the teacher.

The disparity between normal conditions of schooling and the peculiar conditions in such places as Lewis calls for some consideration in the assessment of abilities and aptitudes, the significance of the language difficulty in its various aspects being taken into account. Accordingly the Research Council resolved upon an attempt to carry out testing in Gaelic and to analyse the results in order to isolate the effect of using the more familiar language. The most satisfactory method was thought to consist in testing in English and then repeating the procedure along similar lines in Gaelic to estimate the effect of the testing language upon the scores obtained. That the maximum number of cases might be recorded a group-test had to be used, a test readily adaptable to Gaelic translation. And since comparative scores, Gaelic and English, were required, the test selected had to be one which was published in two more or less parallel forms. The choice of the committee fell upon Cattell's Non-Verbal Intelligence Test, Scale I, which is obtainable in parallel forms, A and B. The description 'non-verbal' refers to the response to the test, which lies in making some kind of mark or line with a pencil on a picture or drawing in the test booklet. No verbal responses are made during the test proper, either orally or in writing. The test instructions, on the other hand, are purely verbal in character, spoken by the examiner before each part of the test, so that the child's score depends almost entirely upon the degree of his comprehension of the spoken instructions. The next step in the planning of the experiment was the translation into Gaelic of Form B of Cattell's test.[1] A draft of a Gaelic translation, prepared by a competent and authoritative Gaelic scholar, was submitted for approval to other judges and the groundwork was completed. At this stage a preliminary try-out was planned to assess the value of the translated test. The real motive of the try-out was to 'test the test' as a valid measure of the intelligence of Gaelic-speaking or rather bilingual children. In the second place, should the test prove satisfactory on statistical analysis, it would be interesting to have objective estimates of the relative results obtained in the Gaelic test and in the standard English version. If scores or intelligence quotients were substantially the same after the children had been given the opportunity of responding to testing in Gaelic, then this particular method of research would appear to be unfruitful. Meantime the effects of testing with Form A in English, followed by Form B in Gaelic, were to be investigated, and in fact increases in score due to the use of Gaelic on the second occasion were expected with some confidence.

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[1] Permission kindly granted by the publishers, Messrs G. G. Harrap & Co., Ltd. The Gaelic versions are available only to research students.

The use of Cattell's Scale I involved the constant sequence, Form A followed by Form B, because Cattell has standardised Form B by making an allowance for the practice effect resulting from previous experience of Form A. In the Lewis experiment, therefore, the expected increases in Form B scores could be apportioned to practice effect and language facility separately. Cattell has tabulated the expectation of increase due to practice in a twofold table based on chronological age and raw score, the use of Form B being strictly confined to cases previously tested on Form A and an allowance varying from three to seven points of raw score being made for practice effect. Incidentally he assumes the complete disappearance of practice effect if there is a lapse of about a year between test and re-test.

In undertaking the experimental try-out of the Gaelic test the main aim was to record results for as many cases as possible within a time-limit which was of necessity rather short. Within four weeks test results had to be obtained from a random sample of bilingual children in Lewis. The nature of the experiment demanded that every group be tested twice, once in English and once in Gaelic, within a short interval of time; thus the difficulty of transport and the pressure of time imposed rather intensive test concentration upon the children included in the testing. At the most two days were allocated to the double test, but actually in some instances both A and B Forms were given to the same group of children in the same school-day. In two cases of emergency the double test was administered during the extended morning session because extremely bad weather conditions caused the schools concerned to close for the day at one o'clock. Statistically the results obtained under those forced circumstances were given identical treatment with the other results. Perhaps, after all, the intensified effects of recency and practice counterbalanced the effects of fatigue.

The procedure to be adopted in testing is rigidly laid down in Cattell's test instructions, the actual wording to be used being, therefore, invariable. The construction of the test, specifically designed for children of mental ages between 8 and 12 years, indicates the range within which testing can be effectively carried out. To obtain an entirely random sample of Lewis children the proposal was to test three age-groups in representative schools throughout the island. Age-groups 8, 10 and 12 years were selected, the groups being defined from an arbitrary date in April, so that in October when the actual testing took place the ages of the groups of children were between 7½ and 8½ in the youngest group, between 9½ and 10½ in the intermediate group, and between 11½ and 12½ in the oldest group. To ensure the most extensive sampling possible within the limited time a varied selection of schools was included in the twelve in which the opportunity of testing was provided. The largest rural school in the island and one of the smallest schools were visited, as well as those of moderate size. The largest school serving a district which is, relatively considered, populous had a staff of some ten or twelve teachers; the smallest school, remotely situated in a lonely glen, stands in isolation, roughly equidistant from a few scattered hamlets within a radius of, say, four miles, and it has about twenty pupils on the roll. In the twelve schools visited each of the four parishes in Lewis appeared to be fairly well represented.

To utilise every school-day for testing the writer had to avoid travelling from place to place during school hours. Consequently it seemed advisable, in schools where the numbers were small, to complete the work in the school in one day, and to devote two days to as many of the other schools as possible. (Of course the ideal time-interval between tests was being sacrificed in the drive for a large number of cases.) Original plans miscarried seriously on only one occasion because of the idiosyncrasies of local transport services, and cost the loss of one valuable day's work. Two other factors affected the testing campaign adversely—consistent bad weather during the four weeks of testing and an exceptionally late harvest, both causing irregular attendance. Frequently the investigator had to discard a child's first score altogether because his absence at the time of the second testing made comparison of scores impossible. This was a fairly common occurrence in schools where the two tests were given on consecutive days. One advantage of completing the work within one school-day was that fluctuations in the numbers from test to test did not occur. October 1943 in Lewis was characterised by continual downpours of rain. Between the downpours children were required at home to secure the last of the crops for what they were worth. The weather in Lewis is totally unpredictable at any season, but even so, it would probably be wiser to plan any large-scale testing to occur during summer.

Cattell's guiding principles in the construction of his non-verbal group-tests explain their content. He aims at including only such types of test as are highly saturated with Spearman's 'g'. Scale I comprises a battery of eight tests, in which substitution, analogies, a maze, carrying out instructions, and picture completion, for example, are included. His presentation of test items is in pictorial form throughout, to offset the operation of a verbal facility factor as far as is compatible with a high saturation of 'g'. In each of the eight tests the items are graded progressively so that every child can tackle the easier items at the beginning, being held up only when more difficult items appear demanding a higher degree of intelligence for their correct solution. Every test, too, is preceded by three practice items for which the score is not taken into account as they are solved with the guidance of the examiner. In this way the child is prepared to tackle the test proper. Half-way through the test the provision of a few minutes' interval combats to some extent the onset of fatigue.

Before presenting an interpretation of the statistical analysis which was made later, it might be well to point out a few of the children's specific difficulties which may have some bearing on that interpretation. Now and then some aspect of a test was unfamiliar to those children when the average child in a mainland school would have given a correct response with mechanical ease. Test performance and scores must have been affected to a considerable extent by the content and the presentation of items.

It seems unlikely that the ability to interpret pictures and to respond with meaning is so well developed in the island children as in most others. They find little stimulation of their powers of pictorial appreciation outside their school experience—that is to say, in school textbooks and in wall pictures. It is making a heavy demand on a child who is practically picture-starved to read meaning into unfamiliar pictures. Certainly visits to the cinema have not developed the faculty. During the war years the Ministry of Information has improved the situation slightly by arranging annual visits from a mobile unit. Nor are picture-books in plentiful supply in the home. No more are children's 'comics' in circulation in the community. The visual-mental co-ordination, which is for these reasons undeveloped, cannot be effectively brought to bear on the test content. Unreceptive of pictorial stimuli because of relative inexperience, Lewis children are handicapped from the outset in this type of test. Regarding the maze tests which Cattell includes in Scale I, we should say at a hazard that about eighty per cent. of the Lewis children tested were confronted with the problem of proceeding through a maze on paper for the first time. On the mainland many children are doubtless familiar with the problem. The speed of execution in that particular test would vary very greatly according to training, so that the novelty of the situation retarded progress in the case of those children more than it would usually.

Many of the objects represented in the pictures throughout the test booklet bore no reference to past experience in the life of Lewis children. There are items about trains, for instance, and these demand precise knowledge of their structure and function. Now, the average child in Lewis has never seen nor heard a train. He may have read something of trains, but his experience is at best indirect. One problem on trains, for instance, in the picture-completion test demanded the accurate recall of the arrival of a railway train at a station. The correct insets for the blanks, pictures of the engine and a middle coach, had to be selected from an array of four pictures. Having deduced from the relative positions of train and platform the direction in which the train was travelling, the child was required to select, from the pictures of the two engines which did face the correct direction, that one which, judged by the volume of smoke emitted, appeared to be stationary. There is little hope of any correct solution to that problem—except by pure chance—from the average, or even from the very intelligent, child in rural Lewis.

One further example of the type of item which proved totally unsuitable is the picture in which a girl is standing by a flower-bed under a tree in a garden. The blank in the picture was to be filled by the insertion of a watering-can in the girl's hand. It was not surprising that most children suggested a bunch of blossoming twigs as the suitable inset. There is no need for watering-cans, or indeed for any artificial form of irrigation, in Lewis, and probably very few children know that such objects exist.

These, then, are examples of objects which are unknown, at least in practical experience. There were several such pictures relating to things which have no place in the daily life of the island—highly organised football games, cricket bats, spinning-tops and other toys.

In the Gaelic test there were similar cases of pictures of unfamiliar things—a lamp-post, children at play on a sandy beach, and a toy scooter, for example. It is only from books that Lewis children can learn of these. Only in one or two districts in Lewis are there sandy tracts, so that many children would not readily see the suitability of completing a certain picture by inserting a sand-castle in the foreground. As for the scooter, it must have been a greater mystery. No one who has an idea of the surface and the condition of most of the island's roads would expect children to use such playthings. Indeed, it would be highly dangerous to do so. On the whole, then, it appears that such foreign items are invalid for the purpose, which is to test intelligence with special reference to the possible difference due to changing the language of testing. Unsuitable items probably increased the number of chance responses, in which children often sought satisfaction when all possibility of making intelligent reactions to items faded. It is to be hoped that if unsuitable material made the test undependable in fixing intelligence quotients, at least the number of undiscriminating items in both test forms was roughly equal, so that the comparison between the raw scores for both forms was reasonably fair and true.

Regarding the test behaviour of the subjects concerned, some general impressions of their temperament and character—in so far as such generalisation may be made—should be given because of their intrinsic importance in such situations. The reactions to the test situation of the children were most interesting. It seemed from their bearing to be an occasion for great solemnity—or did they merely indicate passive suffering?—and it was obviously necessary to relax the tension before a favourable start could be made. Their own consciousness of an inadequate knowledge of English, on which they were to be judged for some obscure, ill-defined purpose, seemed to cause them a good deal of misgiving, if outward appearances could be interpreted correctly. The purpose may be described as 'ill-defined' from the point of view of the subjects because, in the light of experience, motivation was insufficient. They were simply told to do their best to solve the puzzles, and to look very carefully at the pictures before drawing any lines on the pages. Instead of showing the enthusiasm which is common among children about to be tested, Lewis children seemed to be rather ill at ease, as if afraid of being found wanting, and rather reluctant to reveal their shortcomings in the comprehension of English. The bilingual child's sense of his inability to speak English, and to understand it as well as is expected of him, has its source in the abrupt transition at the early age of five to expression through the medium of a new and hitherto unknown language. Without doubt many experiences in his early school career consolidate the sentiment, while occasional contact with English-speaking visitors also serves to confirm his sense of backwardness. Perhaps this is the fundamental cause of the shyness and reticence which is so clearly characteristic of the great majority of Lewis children, at any rate in their dealings with strangers. Rather than expose their scanty knowledge of English they seem to take evasive action in aloofness, which is probably the product of consistently defensive behaviour in the past. It is not surprising to find children in the younger classes rather slow and deliberate in thought and speech when the language used is English.

It is clear in these circumstances that the time factor has a profound effect on test results over and above the normal effect. A rigidly timed test does not seem to discriminate

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very well in the upper range of the intelligence scale, because mental processes which are more slowly initiated and pursued than is usual are constantly being interrupted and suspended by the imposed speed of the examiner. It is doubtless true that Lewis children are temperamentally unresponsive to the pressure of time. They seem to reflect in temperament and character the life of generations of their island race. Their unhurried, untrammelled mode of existence, remote from many of the mechanised complexities of urban civilisation, naturally affects their outlook on, and their approach to, life. Generally speaking, there is a strong tendency in the island character towards a lackadaisical acceptance of whatever may transpire. Admittedly this tendency is often checked in later life by the urge and ambition arising from superior intelligence and strength of will. But there is little evidence of the modern tendency to race with time. It is rightly considered infinite and unlikely to interfere with the expected sequence of things; so in the normal course of events there is no need for undue haste. Probably if the children had grasped more fully the significance of the stop-watch in the experiment the scores would have been more flattering to them.

The statistical analysis of the 1943–44 test results revealed certain points which bear an interesting relation to the inherent conditions and the circumstances of the experiment. The two main points which emerged were: firstly, a significant (that is, 'statistically significant') difference between the scores obtained on the A Form and on the B Form (those obtained on the B Form with Gaelic instructions showing an increase over and above the allowance which Cattell would attribute to practice effect); and secondly, a mean intelligence quotient considerably lower than would be expected from a sample with a normal distribution of intelligence.[1] For this calculation raw scores had been translated into Binet intelligence quotients via the Cattell index, which has an unusually wide standard deviation.

With regard to the first of these results—increased scores in the Gaelic version—the improvement, noticeable in all age-groups, was far in excess of Cattell's expectation. There is, moreover, some doubt regarding the interaction of practice effect, as a result of previous experience, and of the change from language to language in giving instructions. Should the change of language in the second test be thought to reduce practice effect to any extent, still greater then should be the amount of gain ascribed to facility in reacting to Gaelic instructions. That, however, is a somewhat complex question, open to argument.

The tabulation of results according to age-groups shows for Form A a low standard deviation in the youngest group. This restricted degree of scatter suggests at first a more homogeneous group than might be expected, but a truer interpretation, probably, is that the test is not an adequate measure of intelligence within the group. The cluster of scores practically means that the test lacks head-room or foot-room, or more likely both, for assessing that young group. It appears, however, from the analysis of Form B results that there is an increase in standard deviation or scatter, so that the Gaelic test seems to discriminate more effectively within the same group.

In the age-groups of 10 and 12 years there is a greater spread of scores over the range of intelligence, with only slight variations of spread between A-scores and B-scores. This shows that in this sample the older children, drawing on a greater fund of acquired knowledge and on more extensive experience, respond more satisfactorily at the upper level of intelligence to the demands of the test situation. That is to say, the test is more satisfactory for grading older children throughout the range of intelligence; for it is inclined to classify most of the younger within rather narrow limits on that range.

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[1] The IQ was depressed by approximately 15 points.

To turn, now, to the fall below 100 of the mean IQ, the discrepancy is perhaps summed up in the fact that these tests have naturally been standardised on the results of English-speaking children, and in the special circumstances already recounted must inevitably discriminate unfairly against bilingual children drawn from an island population of necessarily circumscribed experience. Only when a reasonably valid instrument of measurement is devised can genuine estimates of their intelligence be obtained. It is imperative to modify test content for that specific purpose and in this way to judge intelligence with greater equity and precision. An answer-pattern, showing which items or types of items have proved unsatisfactory, would provide useful information. Certain items would on that basis be discarded, and would give place to others making similar demands on the child's innate capacity but confining themselves within the probable limits of the child's experience in so far as is reasonable; for example, in a picture test no objects should be entirely beyond the bounds of his personal or indirect experience.

The conclusions drawn from the results of that original try-out in the autumn of 1943 encouraged the Committee on Bilingualism of the Research Council to follow up the investigation which had already yielded some useful information. In the second part of the experiment carried out in the autumn of 1945 the focus was on the possibility of conflict between practice effect and the effect of the change of language. It had been tentatively assumed that the large increases in the 1943 try-out were due to the use of Gaelic in the second test. Part II of the experiment was designed to test the validity of that assumption by changing the order of tests and varying the language of testing for different groups, a procedure which requires a fuller explanation of its intricacy.

The new aim was to investigate the variations in scores between first test and second test in all possible orders of test forms in conjunction with all possible language sequences. One group was to be given Form A in English followed by Form B in English. A second group was to have A in Gaelic and B in Gaelic, a third group A in English and B in Gaelic, and a fourth group A in Gaelic and B in English. In addition, four other groups were to be tested with corresponding language sequence, but given Form B first, followed by Form A. In this way it was hoped to achieve an exhaustive analysis of data by comparing the variance of the eight groups involved. This technique was suggested by Fisher and is described in his *Design of Experiment* and *Statistical Methods for Research Workers*, and is that usually adopted in agricultural and biological experiments.[1] This refinement in method and the subsequent results were expected to yield more precise information than was available from the original results. It had been accepted in the light of the earlier experiment that increase of score in excess of Cattell's expectation was due to greater facility in responding to Gaelic instructions. Could it now be shown that between a first trial in Gaelic and a second in English there was a fall in the average amount of difference?

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[1] *Cf.* also E. F. Lindquist, *Statistical Analysis in Educational Research*. London: George G. Harrap & Co., Ltd.

From replies to a circular sent out by the Research Council it seemed as if between three and four hundred pupils could be tested, but detailed planning was delayed because one or two schools failed to indicate the number of children included in the given age-groups. Thus the probable total of the sample of children was indefinite.

The ideal organisation of the experiment with a total number of 400 children would be to divide the group in halves, the first 200 to be given tests in the A–B order and the others in the B–A order. Each of the halves should then be divided into four equal parts to be tested in the four possible language sequences respectively. The first 50 of the A–B half might do both tests in Gaelic, the second 50 both in English; the third would do A in Gaelic and B in English, and the fourth A in English and B in Gaelic. The B–A half would be treated similarly. In practice such precision of grouping was impossible. Too little time to group children in every school, and test the several groups with their requisite sequence, was available, and so the procedure was restricted to balancing school against school numerically to consider a school as a group. In the two largest schools, however, the whole group was divided into fourths and tested in the required order. One school was placed in the B–A group and the other in the A–B group. But obviously it was difficult to keep the groups level in number; for there were considerable discrepancies sometimes between the estimated number of subjects and the actual number present at school on the day of testing. Besides, faulty estimates had been made originally (of the numbers in two schools) as was discovered on visiting the schools in the last week of testing, by which time it was too late to make new allocations to groups as most of the testing had already been done on the basis of the planned groups.

Such circumstances as these caused a certain amount of upheaval in the numerical balance of groups.

The actual testing in 1945 was essentially the same as in the first experiment. The test conditions as far as the children were concerned were exactly the same, except that for some of them both tests were administered in the same language each time, and for about half of them test B came first. Greater attention had to be given to test records and statements of results, and during the weeks of testing a check had to be kept on the numbers going into each group, schools being occasionally allocated afresh to suitable groups in an attempt to equalise them. Re-allocation was impossible after testing had been done, because sequence of tests and language had already established those schools in their particular groups.

The statistical analysis of the 1945 experiment has been undertaken by Dr D. N. Lawley and is appended, but before presenting these results it may be advisable to record some general impressions derived from the testing.

From a summary perusal of the comparative scores, and this time there are eight groups of scores to be considered, it is clear that there is a larger increase than Cattell's prediction. We should not like to say what the exact amount of the increase is, but we think it is on the average at least double Cattell's prediction. It may be that the experience of doing an intelligence test is so novel to Lewis school-children that the spurt is comparatively greater because of the mediocrity of the first performance. It is not uncommon to find increases of some twenty to thirty points of raw score between the first and second test, probably because the first test was something analogous to a shock-absorber the value of which appears in the re-testing.

From purely superficial observation of the results of the several groups, the writer formed the opinion that the increases are greater in some degree when the language used in the first test is Gaelic. There is one fairly obvious interpretation of this, which is, that after hearing the original instructions in Gaelic, the child is thoroughly cognisant of the test procedure, so increasing his efficiency and speed during the second trial. First instructions heard in English, on the other hand, are no doubt imperfectly apprehended, and time is expended in the second application on trying to understand what is required and to answer correctly. Perhaps, also, some children, discouraged by difficulty in understanding the first test, fail to surmount the mental reaction to initial failure.

One further point is that increase of score is larger when the language of testing is changed. When increases from A in Gaelic to B in English for the first group are compared with increases from A in Gaelic to B in Gaelic the latter are less on an average. If the improvement is more marked when the language is changed, the explanation may be found in the greater effort summoned to respond well to an altered situation. In the case of the group which did both tests in Gaelic, the children's work may have settled down in the second test to a monotonous rhythm because of the close correspondence between the two experiences.

A limited amount of individual testing undertaken in 1943 seems to corroborate many of the findings of the Cattell group testing. The test used was the Terman-Merrill revision of the Binet scale. Only a very small number, ten actually, could be tested in the time at the investigator's disposal. The children tested were given Form L in English and Form M in a Gaelic translation.

No statistical treatment of the results was made because it would be useless to generalise from such a small number of cases.

For temperamental reasons the children seemed to respond badly to the situation. Ordinarily most children co-operate readily, and are keen to acquit themselves well. In the case of the bilingual children, however, it was rather difficult to break down the barrier of reserve and reluctance to answer, which arose as it were involuntarily. Probably it had so often proved a refuge in the past that a more or less permanent attitude had developed from its use. One case may be cited in which the tester felt sure she had not succeeded in gaining the confidence of the child. By objective scoring, her IQ was found to be average or slightly less. Actually she was reputed to be highly intelligent, which there is every reason to believe was the case. But she was petrified at the mere idea of being singled out from among her fellows and at having to communicate her trains of thought in English. Indeed, there was no conspicuous improvement in her performance when the change to Gaelic was made. Temperamental factors continued to impose their restrictions, and little progress could be made.

Not only in this connection but also because of its general application to the conditions of the experiment, it should be mentioned that testing in Gaelic is complicated by the intrusion of involuntary English associations in the minds of the children. For instance, Gaelic-speaking children in Lewis almost always count in English, because number concepts are purely the product of the schoolroom learning. They may mention numbers in Gaelic in the course of conversation, and then only if they are referring to 'round' numbers, such as 100's, or to small numbers. Gaelic numbers are rather clumsy to express because they are expressed in multiples of twenty, so that it is easily seen why children more naturally use English numbers. They have been drilled in arithmetic in school and are much more accustomed to the English way of expressing numbers. As for arithmetical calculation, that is done exclusively in English.

In testing a child of ten the writer was struck by the complexity of mental processes involved in his response to an item concerned with number concepts. He hears, for example, 'count the blocks' spoken in Gaelic. His normal practice is to count in English in accordance with his school training. He finds the answer and translates it into Gaelic to give his response, or perhaps, out of habit, forgets that the language used was Gaelic and gives his response in English. Responses in English to Gaelic questions were frequently found from the few pupils tested. The English form arises as a kind of conditioned response; and it is not surprising that conditioning has become effective over a period of, say, five years' training from age five onwards. There seems to be a prevalent idea that English is the only permissible medium of expression in school.

As in the case of the Cattell test, there appears in the Binet scale a number of unsuitable items as far as Lewis children are concerned; items about trains and engine-drivers, word association, abstract words and rhymes all appear to cause considerable difficulty. In the Gaelic version it is useless to present dissected sentences to a child for reassembly in the correct order; for he has not been taught Gaelic and cannot read it. The 'Memory for Sentences' test, too, presents more difficulty to Lewis than to mainland children. For example, 'the clowns at the circus' is a mere collection of words to them, since there is little likelihood of a mental picture of a circus presenting itself in the child's mind to 'take the strain,' as it were, of the question. No Lewis child has seen a circus, and very few have read about one.

To sum up the general findings of the series of tests administered, bilingual children seem to respond more adequately when tested in their native tongue—Gaelic. Even in these circumstances the results are, on the whole, lower than should be expected because the tests themselves are in some degree ill-adapted in content for the purpose; further, the children are also to some extent handicapped by reason of temperamental and environmental factors. Satisfactory test conditions would, therefore, involve refinements in the instrument of mental measurement and in the method of presentation. And it is only by securing satisfactory test conditions that one may hope to breach the evident gap between actual and potential achievements of bilingual children in the field of testing.

These considerations suggest that there is a case for making more use of the Gaelic language as a teaching medium in schools in Gaelic-speaking districts. Educational methods, hitherto, have precluded the coherent development of the bilingual child's mental capacities. It might be advisable to postpone the learning of English from age five to a more mature stage, when the acquisition of a new language would be easier and more speedy, particularly when there are numerous influences predisposing to successful learning of English at a later stage. The fact that testing in English gives rise to faulty assessments of ability is a serious reflection upon the present educational system, which demands from bilingual children the level of attainment recognised throughout the county as the requisite for promotion from primary to post-primary schooling. This state of affairs cannot but necessitate undue pressure on bilingual children in primary schools, and the remedy seems to lie in more sympathetic administration to solve their specific problems and correct the errors of the past.

STATISTICAL ANALYSIS[1]

ALTOGETHER 415 Gaelic- and English-speaking children were tested, each child being given both the A and B forms of R. B. Cattell's group Intelligence test. The children were chosen from three different age-groups; they were either 8, 10 or 12 years old at date of testing. Various methods of administering the tests were adopted for the purposes of the investigation. There were two ways of varying the order according to whether Form A or Form B was given first. There were also four different ways of arranging in which languages the tests should be given. Either both tests could be given in English or both in Gaelic, or the first test could be given in English and the second in Gaelic, or the first in Gaelic and the second in English. Thus, taking into account the classifications according to age of child, order in which Forms A and B were given and language permutations, the children could be divided into $3 \times 2 \times 4 = 24$ sub-groups. In each sub-group the subjects belonged to the same age range and were given the tests in the same order and in the same languages.

No account was taken of the different schools from which the children came, as it was considered unlikely that this would have any material effect on the results. An attempt was made to ensure that the numbers of cases in the various sub-groups should be as nearly equal as possible, though complete equality was obviously impossible of attainment owing to factors beyond human control.

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[1] The data on which this analysis is based are given in the Appendix.

The chief object of the experiment was to investigate the effect of language on test score. The first step was therefore to find for each child the amount by which the score on the second test exceeded that for the first test. The difference between the two scores was mainly due to practice effect, but might in addition be affected by the languages in which the tests were given, and also by any difference in difficulty between Forms A and B.

It was decided to begin by testing whether the score increases depended upon the age of the subjects tested, *i.e.* whether the older children gained more points of score due to practice than the younger children. The following Table gives the mean score increase for each age-group:

Age in Years	Number of Cases	Mean Score increase
8 . . .	155	10·67
10 . . .	129	11·22
12 . . .	131	11·28

Analysis of variance showed that the apparent differences between the three age-groups were not significant, the mean square for differences between groups being in fact considerably below expectation.

ANALYSIS OF VARIANCE

	d.f.	Sum of Squares	Mean Square
Between age-groups .	2	33·21	16·60
Error . . .	391	26086·25	66·72

In the above analysis the 'error' sum of squares was that due to differences within the 24 sub-groups previously mentioned and was therefore based on $415-24=391$ degrees of freedom.

Neglecting now the effect of age, the following Table was constructed showing the mean increases of score from first to second test for the two different form orders and the four language permutations:

	(GE)	(GG)	(EE)	(EG)	Average
(AB) .	12·32 (41)	11·58 (48)	11·00 (57)	10·28 (60)	11·19 (206)
(BA) .	12·13 (52)	9·33 (46)	9·75 (60)	12·35 (51)	10·89 (209)
Average .	12·22 (93)	10·48 (94)	10·36 (117)	11·23 (111)	11·04 (415)

In this Table the figures in brackets denote the numbers of cases on which the means were based. The heading (GE) denotes that the first test was given in Gaelic and the second in English, and similarly for the others. In the same way (AB) means that the first test was Form A and the second Form B, and vice versa for (BA). Thus the group of 41 children with a mean score increase of 12·32 was given Form A in Gaelic followed by Form B in English.

The analysis of variance[1] performed on these figures is shown below.

	d.f.	Sum of Squares	Mean Square	Variance Ratio
Between form orders . .	1	9·60	9·60	. .
Between language combinations .	3	216·47	72·16	1·08
Between classes .	7	500·67	71·52	1·07
Error . .	391	26086·25	66·72	. .

From the analysis it will be seen that the mean square representing differences between the eight groups is only slightly greater than the error mean square, and is not therefore significant. Subdividing the seven degrees of freedom, we find that neither differences between form orders nor differences between language combinations attain significance, the mean square in the first case being far below and that in the second case only slightly above the error mean square. It would thus appear that the average score increase is substantially the same whether Form A or Form B is given first, *i.e.* that the two forms can be assumed to be of equal difficulty. Secondly, we are justified in concluding that the practice effect is the same whatever the languages in which the tests are given. The results of the experiment would seem to indicate that the children were equally good at comprehending English and Gaelic.[1]

---

[1] In the above analysis of variance the various effects have been treated as though they could be separated completely from one another, *i.e.* as though there were complete 'orthogonality.' This assumption is not strictly justified on account of the inequality of the numbers of cases in the various sub-groups. The degree of non-orthogonality is not sufficiently large, however, to have any effect on the conclusions drawn, and it was not considered worth while to have recourse to the method of constant fitting developed by F. Yates.

The mean practice effect was estimated to be 11·04 points of raw score, with a standard error of

$$\sqrt{\frac{66{\cdot}72}{415}}=0{\cdot}40.$$

We are therefore fairly safe in making the rough statement that the true amount of the practice effect lies between 10 and 12 points of raw score.

Though not one of the main objects of the investigation, an examination was made to discover whether there was any relationship between the child's total score and his gain due to practice. The correlation coefficient between the sum and difference of the scores in the two tests was found, however, to have a value of only ·064, which for a sample of 415 cases does not approach even the 5 per cent. level of significance. There is thus no obvious dependence of practice effect on level of performance.

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[1] It must not be inferred from this that there is no all-round handicap from the introduction of the second language.—GODFREY THOMSON.

APPENDIX

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APPENDIX

AGE-GROUP	Group AB (i)		Group AB (ii)		Group AB (iii)		Group AB (iv)	
	Ag	Be	Ag	Bg	Ae	Be	Ae	Bg
8 years	11	24	10	14	11	34	20	12
	15	23	9	20	5	19	37	43
	9	15	6	3	12	28	21	28
	29	44	14	20	21	30	15	26
	6	13	18	24	6	10	15	22
	11	19	14	26	17	33	26	25
	3	7	19	17	7	9	20	33
	18	30	22	27	9	15	11	29
	17	37	23	38	13	18	16	21
	17	28	10	9	13	18	3	29
	17	28	16	38	17	38	18	29
	9	21	21	36	27	29	21	27
	13	24	12	40	26	55	11	16
	23	38			0	12	45	58
	7	20			6	24	11	20
	9	23			5	14	6	20
					14	25	15	16
							19	47
							24	40
							29	33
							25	26
							10	23
	214	394	194	312	209	411	418	623
10 years	20	25	29	35	54	59	41	61
	40	51	38	49	55	60	54	65
	29	46	20	30	49	58	42	64
	45	55	51	60	31	38	44	66
	34	50	56	65	43	41	40	43
	7	26	23	40	51	61	33	48
	49	63	29	39	47	60	42	49
	39	61	42	40	52	67	22	30
	18	20	10	13	35	45	16	24
	35	40	41	60	69	74	40	57
	29	29	8	35	29	44	22	41
	11	28	31	46	69	70	33	39
			41	48	27	42	44	50
					40	64	37	30
					27	40	48	49
					39	56	40	39
					27	62	26	40
					47	53	10	22
					31	53	18	40
							43	49
							32	45
							40	55
	356	494	419	560	822	1,047	767	1,006

Age-Group	Group AB (i)		Group AB (ii)		Group AB (iii)		Group AB (iv)	
	Ag	Be	Ag	Bg	Ae	Be	Ae	Bg
12 years	46	56	29	51	74	80	60	69
	66	76	61	75	71	74	55	65
	34	52	38	47	62	82	49	61
	49	66	83	90	76	75	61	85
	48	48	46	70	34	60	55	62
	43	51	36	43	79	74	54	65
	32	49	32	44	39	56	59	57
	55	78	40	49	51	64	68	78
	62	71	64	64	73	76	59	63
	29	43	68	72	52	51	61	55
	35	57	39	61	60	71	41	46
	36	55	58	68	58	68	47	63
	20	40	51	73	61	68	63	66
			41	53	59	66	21	46
			55	74	65	71	39	66
			44	65	64	79	28	46
			67	77	46	59		
			45	57	44	57		
			43	51	56	62		
			43	68	35	49		
			61	80	32	49		
			31	40				
	555	742	1,075	1,372	1,191	1,391	820	993

Age-Group	Group BA (i)		Group BA (ii)		Group BA (iii)		Group BA (iv)	
	Bg	Ae	Bg	Ag	Be	Ae	Be	Ag
8 years	24	32	11	24	23	35	0	2
	12	22	7	15	32	31	4	2
	16	15	10	23	21	25	6	28
	20	25	23	39	11	16	0	2
	8	10	36	40	8	24	9	19
	20	31	11	8	5	13	0	0
	19	24	23	32	16	25	0	6
	12	29			11	8	8	11
	20	35			21	36	30	28
	7	9			4	5	4	28
	11	21			28	37	12	15
	16	23			4	12	10	49
	12	21			18	33	10	32
	20	37			16	43	4	17
	16	15			3	19	25	37
	10	28			2	13	17	27
	15	36			8	18	5	36
	8	24			18	32	9	31
	16	17			28	45	13	28
	16	21			11	29	9	16
					11	31	14	16
					12	22	10	25
					19	28	8	38
					10	13	7	20
					2	16	20	26
					18	33	6	15
					11	28	15	29
					9	16	26	43
							24	39
							13	28
							12	29
							10	24
	298	475	121	181	380	686	340	746
10 years	24	47	21	29	66	81	48	44
	28	35	31	38	22	14	40	50
	32	62	37	43	13	26	24	37
	52	39	36	47	34	33	17	23
	54	72	29	30	34	54	17	46
	20	28	33	48	12	14	20	32
	22	38	47	58	47	56	23	46
	47	60	27	26	42	53	17	18
	28	35	44	54	24	38	38	47
	19	52	46	44	30	42	15	17
	18	44	57	52	30	45	24	34
							29	56

Age-Group	Group BA (i)		Group BA (ii)		Group BA (iii)		Group BA (iv)	
	Bg	Ae	Bg	Ag	Be	Ae	Be	Ag
10 years (*cont.*)	26	44	38	60	18	33	51	62
	20	31	27	35	45	63		
	11	31	20	23	46	54		
			46	56	33	46		
			14	25	41	48		
			16	35	36	49		
			26	39	44	60		
	401	618	595	742	617	809	363	512
12 years	52	62	49	66	75	76	44	62
	66	80	51	77	66	73	61	63
	49	58	26	49	59	64	39	54
	56	79	41	60	52	49	54	62
	37	64	48	56	57	63	42	69
	36	58	60	68	73	76	62	67
	56	66	49	63	58	67		
	51	75	46	61	79	70		
	61	62	56	62	61	77		
	55	58	64	77	42	46		
	38	58	53	54	37	58		
	56	53	37	43	60	81		
	36	61	55	66	61	65		
	32	46	41	54	55	57		
	58	54	31	40				
	35	63	49	59				
	49	63	65	76				
	70	70	73	73				
			75	77				
			33	48				
			65	60				
	893	1,130	1,067	1,289	835	922	302	377

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